HEWLETT-PACKARD COMPANY   PATENT APPLICATION
Intellectual Property Administration
P.O. Box 272400
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Fort Collins, Colorado 80527-2400

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):   Robert G. Gann

Serial No.:   09/845,852   Examiner: Seung C. Sohn

Filing Date: 04/30/2001   Group Art Unit: 2878

Title: METHOD FOR COMPENSATION FOR DUST FOR AN IMAGE SCANNER WITH A MOVING DOCUMENT

AFFIDAVIT UNDER 37 C.F.R. 1.131

THE ASSISTANT COMMISSIONER OF PATENTS
Washington, D.C. 20231

Sir:

I, Robert G. Gann, being duly sworn, depose and state as follows:

1. I am the inventor of Patent Application Serial No. 09/845,852. As supported by the following attached documents, I conceived, in the United States of America, prior to March 1, 2001, the invention described and claimed in the above identified patent application, including:

A method, in an image scanner, for detecting a defect, comprising:
    determining whether lines are present in image data for multiple color

    channels; and

    determining whether calibration gains for photosensors corresponding to the

    lines are normal.

and,

A scanner, comprising:
    a first line-array of photosensors;

    a second line-array of photosensors;

    a processor; and

the processor determining that a defect exists when lines are present in image data from only one of the first and second line-arrays of photosensors and when calibration gains, associated with photosensors corresponding to the lines, are normal.

Diligence, from just before March 1, 2001 to the filing of a patent application, is demonstrated by the filing date of April 30, 2001 for the above-identified patent application.
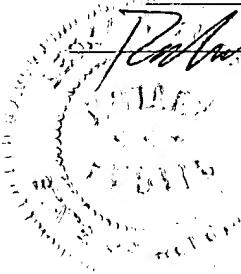
3. Exhibit A is a copy of a four page company confidential Invention Disclosure form, submitted to the Hewlett-Packard legal department on a date prior to March 1, 2001, and witnessed by others.

4. The dates on Exhibit A, and non-relevant information, have been obscured pursuant to my attorney's instructions.

5. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

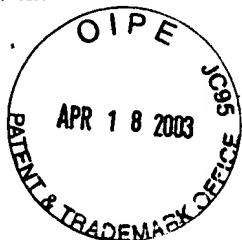Date: _____3/24/03_____

By: _~Becky Stepp~_
8/30/05

Robert G. Gann

Instructions: *The information contained in this document is* **COMPANY CONFIDENTIAL** *and may not be disclosed to others without prior authorization. Submit this disclosure to the HP Legal Department as soon as possible. No patent protection is possible until a patent application is authorized, prepared, and submitted to the Government.*

Descriptive Title of Invention:
Use of dual detectors to improve calibration by identifying dust, dirt or defects in scanning window during calibration or scan.

Name of Project: N/A

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gs;

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(If more than four inventors, include additional information on another copy of this form and attach to this document)

EXHIBIT 'A'

Signature of Witness(es): *(Please try to obtain the signature of the person(s) to whom invention was first disclosed.)*

The invention was first explained to, and understood by, me (us) on this date: [04-JAN-2001 　　　　]

Full Name	Signature
David W. Boyd	David W. Boyd

APR 18 2003

Full Name	Signature
Kurt E. Spears	Kurt E. Spears

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Description of Invention:

A common problem with scanners, particularly scroll feed scanners (scanners where the paper moves in front of the imaging element instead of the imaging element moving relative to the paper) is the introduction of dust or other defects between the original and the sensor during the scan, or between the original and calibration area during calibration. This may cause a vertical streak in the scanned image that, because it is very sharp and regular, is quite obvious. The defect causes a vertical streak because the dust/debris does not move with the paper but remains fixed in position for a significant amount of time. In extreme cases it may cause changes in the threshold level and cause a fully black or white line to appear vertically in the original. While this a problem with scroll feed scanners, it may also be a problem with flatbed scanners fitted with a scroll feed ADF (automatic document feeder). During ADF operation, the flatbed scanner carriage is fixed in position and the ADF moves the paper.

With the introduction of dual imaging elements (dual sensor or dual CCD) in HP scanners there is the opportunity to address this problem. It could be addressed both during calibration and scan, but the more interesting problem is during the scan. This invention discusses how to use the dual images to recognize streaks introduced during the scan by dust or defects and compensating as well as during calibration.

Improved (PRNU) Calibration:

During calibration, sometimes called PRNU and sometimes called "shading" a scan of a known calibration target is made. Since the target is known and is presumably uniform, any pixel to pixel variation can be attributed to sensor, light source or other system non-uniformity. That variation is measured and then a correction factor (gain and/or offset) calculated and applied to subsequent scans.

One of the factors that can impact the quality of PRNU is the fact that dust that is between the imaging head and calibration area during calibration may not be present during the scan. During calibration, the dust causes a variation that is attributed to a system non-uniformity and a correction factor is calculated and applied. Then during the subsequent scan, the dust is not present and the correction factor is applied inappropriately. Typically, but not always, the dust will cause a lower response during and then, during the scan, the correction factor will cause a light streak to appear.   calibration

In the case of scroll feed scanners, the location of calibration and the location where the image is captured from the page during a scan is fixed. However, this does not alleviate the problem because the dust seen during calibration may be behind the paper during the scan, and again, the inappropriate compensation causes a streak in the scan.

In the case of flatbed scanners equipped with scroll feed ADF the location that is scanned for calibration and the location of the paper during a scan may or may not be the same, however, the same problems exist.

→ With a dual sensor CCD the calibration can be performed on each sensor and then compared. Since the two sensors are not imaging the exact same place, it is unlikely that dust will impact both. If a second calibration is performed with the locations being used for the 2 sensors reversed, one could analyze if dust or other defects are impacting calibration in one case. In the case of no dirt/dust, the calibration compensation values calculated for each sensor should be virtually identical for either of the two calibrations. If it is found that the values are significantly different, particularly if the difference is a small localized point, then the presence of dirt or defects in the calibration can be surmised and the "clean" calibration used.

Improved scanning performance.

The more difficult problem is that during a scan, dust may appear and disappear, or move around, due to the motion of paper. Therefore a streak caused by dust or dirt may appear and disappear randomly.

→ With dual sensors, dust or debris that enters the scan path is unlikely to impact both sensors at the same time – since they are imaging different locations. By comparing the images from the two sensors and looking for consistent vertical streaks that appear in the image from one sensor, but not the other, one can identify that some debris is impacting the scan from one sensor, then substituted the image from the second sensor.

This could be achieved by running a correlation on the lines captured by the two sensors from corresponding locations on the page (one will be delayed in time from the other). If the correlation is good, then no dust/debris exists and the images are fine. If the correlation is poor, further analysis could identify the image that is being impacted by dirt/debris and the "good" image substituded.

A. Prior solutions are:

None known

B. Problems solved by the invention.

Introduction of dust during a scan or calibration that creates vertical streaks in the image.

C. Advantage of the invention over what has been done before.

Better images.

D. Description of the invention

See above